MAINTENANCE INFORMATION FOR THE

FUNCTION GENERATOR NO. 40600/40620

ENERGY CONCEPTS, INC.

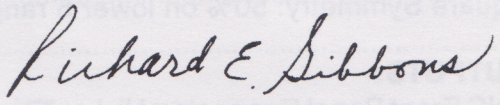
INTRODUCTION

This manual provides maintenance information for the Energy Concepts FUNCTION GENERATOR, Model No. 40600-40620. Read this manual thoroughly before you use the unit. Additional information for the unit is also included in the OPERATION INFORMATION FOR THE FUNCTION GENERATOR, manual number 40609.

Each new unit has been thoroughly inspected, adjusted, and tested before shipment from the factory. As soon as you receive the unit, inspect the shipping carton and the equipment for damage. Report any visible damage to your local carrier for repair or replacement. If the unit does not function properly, or if you have any questions, contact the Energy Concepts Service Center.

This instrument is backed by more than 60 years of experience in designing and manufacturing educational and practical training equipment. Every effort has been made to design into each unit a maximum degree of dependability, accuracy, and durability. New products are being designed constantly to meet the needs of both education and the service industries. We welcome comments that you may have about our products or test equipment.

It is both a privilege and a pleasure to continue serving you.



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MAINTENANCE INFORMATION

SECTION 1

GENERAL

The Energy Concepts Function Generator is a precision instrument which, when used and maintained properly, will provide years of trouble-free operation. However, when service is required, the chassis parts and circuit board components are easily accessible and clearly identified for convenience in troubleshooting.

NOTE

ALL TROUBLESHOOTING, COMPONENT REPLACEMENT, AND ALIGNMENT OF THIS INSTRUMENT SHOULD BE PERFORMED BY AUTHORIZED, QUALIFIED SERVICE PERSONNEL ONLY.

CASE REMOVAL

1. Disconnect the AC power cable from the AC source. Remove all test leads from the front panel.
2. Use a $^{9}/_{64}$" Allen wrench to remove the four Allen-head cap screws from the end caps.
3. Lay the end caps and screws to one side.
4. If the unit is not in a portable case, it may be held by a screw on the bottom of the shelf. Proceed to step 7.
5. Use a pliers to remove the strain relief that holds the power cord on the back panel.
6. Use a #1 Phillips screwdriver to remove the strain relief plate.
7. Use a $^{1}/_{4}$" bladed screwdriver to remove two screws from the bottom.
8. Remove the unit from the case by sliding the unit forward.

CIRCUIT BOARD COMPONENT IDENTIFICATION

Figure 1, on the following page, shows the electrical components mounted on the top of the circuit board. It will aid in locating and identifying the various mounted components. The foil on the bottom of the circuit board is also shown (superimposed) to aid the servicepeople in visualizing the electrical connections.

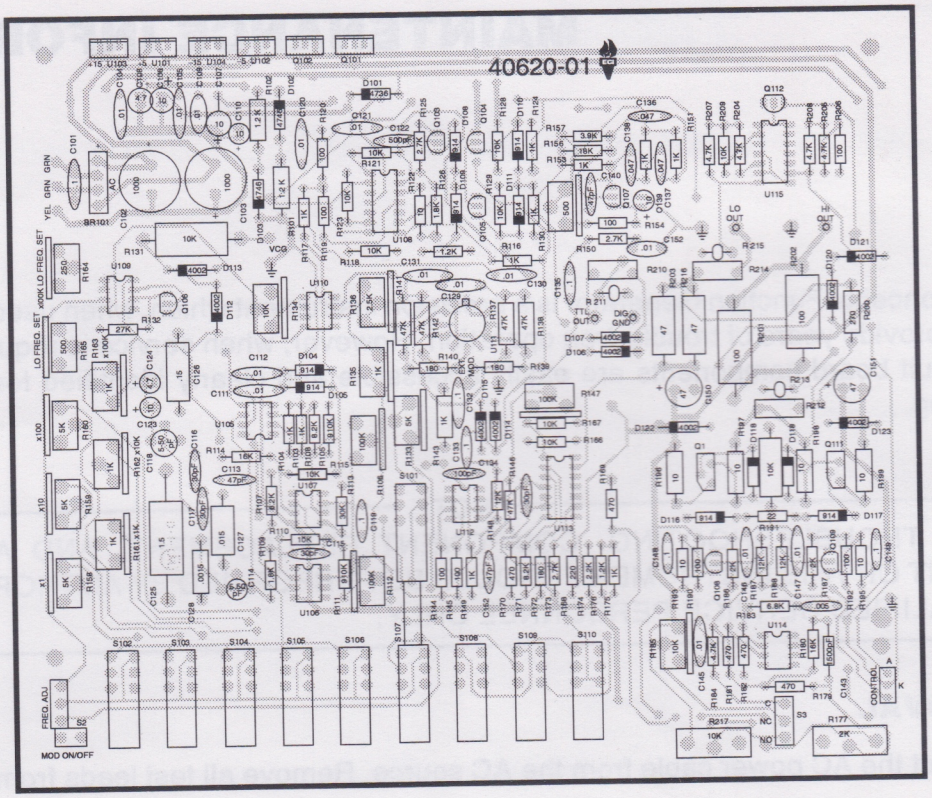


FIGURE 1, Circuit Board Viewed from Component Side

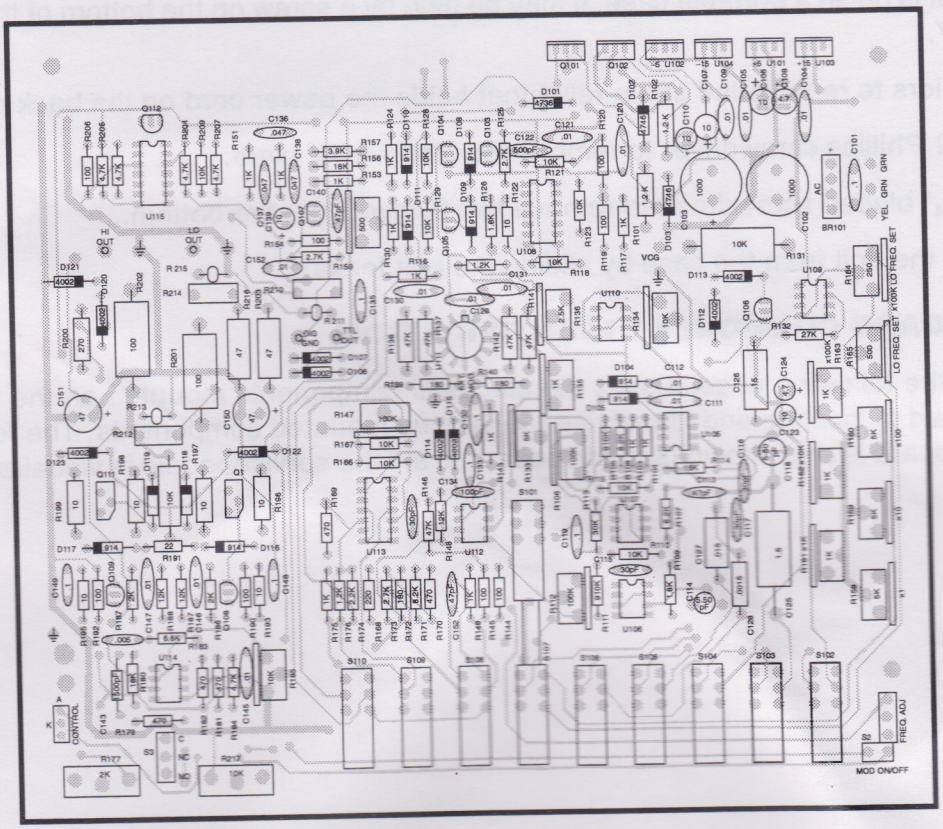


FIGURE 2, Circuit Board Viewed from Bottom Side

CIRCUIT DESCRIPTION

Figure 3, on the following page, is a simplified functional diagram of the Function Generator. It is included to show how the individual output signals are developed. A complete schematic diagram is given in the back of the Maintenance Manual. The component numbers given in Figure 2 are correlated to the schematic diagram.

BASIC WAVEFORMS

The Function Generator is built around a basic circuit consisting of an integrator (U105), a buffer (U106), and a level detector (U107). The integrator consists of timing resistors, timing capacitors, and an Operational Transconductance Amplifier (OTA), a special type of OP-Amp, whose output gain is controlled by the current input at its pin 5. This input will set up the charging current to the timing caps. If we assume a positive input at U105, then the timing capacitor will charge positively toward +15V. This voltage is buffered by U106 and fed to U107 through a voltage divider. The trip point of U107 is set up by D104 and D105. As the voltage set up by voltage divider R109 and R110 crosses the trip point, U107 changes state. This reverses the voltage input at U105 and causes the charging current at the timing caps to reverse. This charging and discharging cycle results in a triangular waveform. The level changing output of U107 is a low level squarewave.

FREQUENCY CONTROL

The level of the current applied to pin 5 of U105 is controlled by FREQUENCY ADJUST control R1. The voltage appearing at the wiper of R1 is buffered by one half of U109 and fed to R132 and the other half of U109, which is set up as a current buffer. The current output is in direct proportion to the voltage input at R132. By varying the voltage to R132 by R1, the current input to pin 5 of U105 and its output will vary. This changing output varies the time it takes for the timing capacitor to charge and discharge, thus changing the frequency of the signal out. By switching in different values of timing capacitors, the range in frequency is changed. Trimming of each frequency range is accomplished by timing resistors R158 to R165.

The input to the current buffer U109 is a summing junction where the voltages from R1 and the VCG input are summed up to control the frequency of the signal out. If the FREQUENCY ADJUST control is set to the low frequency side of the dial, a +10VDC input at VCG input will cause an increase in frequency by a factor of 30.

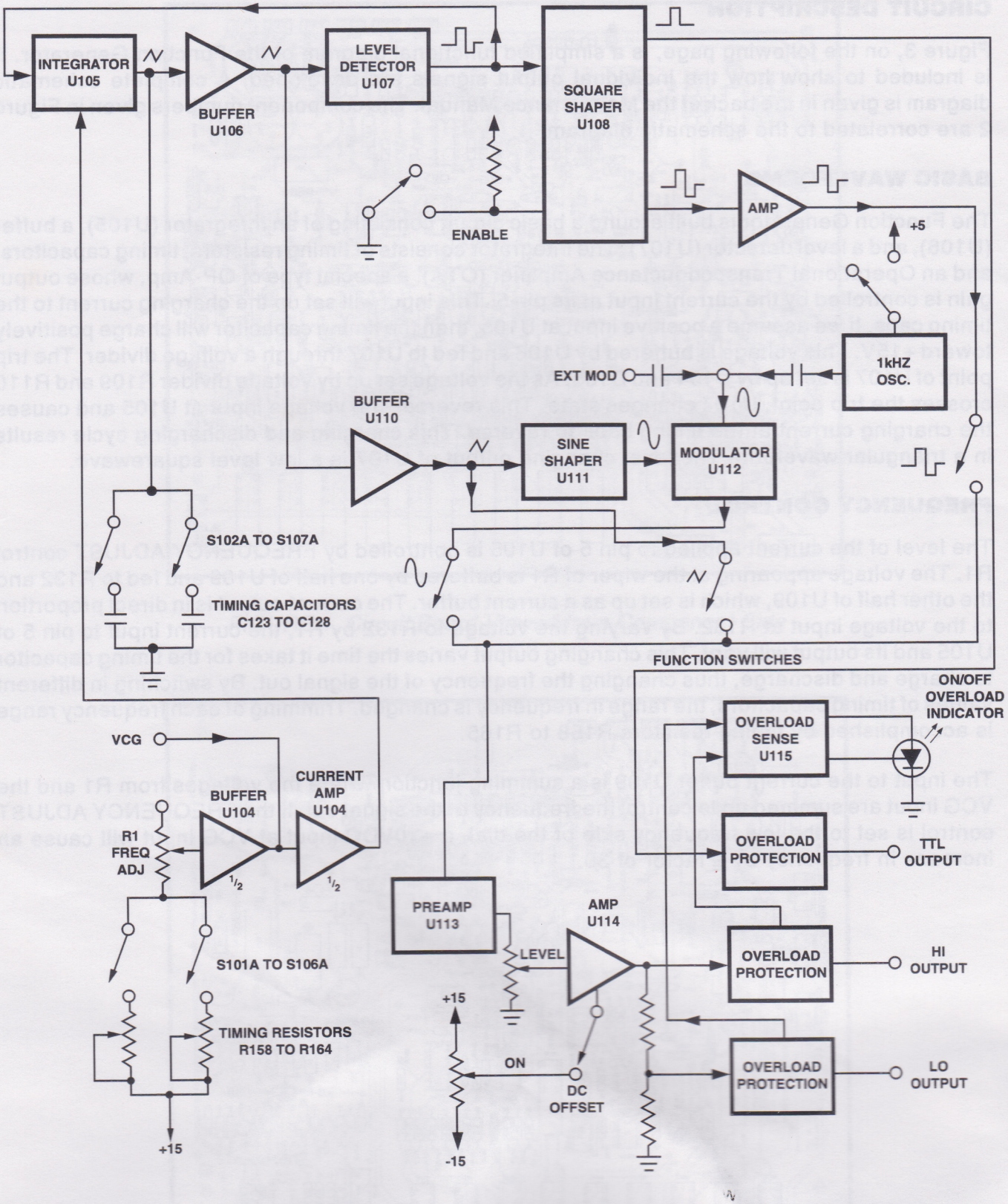


FIGURE 3, Simplified Block Diagram

SQUAREWAVE/TTL

The low level squarewave output of U107 is fed to U108, a dual line receiver, which generates two separate TTL level signals proportional in frequency to the low level input signal.

One of the TTL signals developed by U108 is sent to a shaping network, which changes the +5V TTL level signal to a $\pm 15V_{P-P}$ squarewave. This signal is sent to the function switches. The squarewave function switch disables the output of U108, which generates the squarewave, so that there is no signal developed until the switch is activated. This is done to reduce crosstalk into the sinewave.

The second TTL signal is sent to its protection network (R210, D106, D107) and then to the TTL output connector.

TRIANGLE/SINE

The buffered triangle wave output from U106, aside from being fed to U107, is also fed to U110. At U110, the signal is buffered and sent to the function switches and to the sine shaping circuit U111. U111, a low capacitance diode array, along with associated biasing resistors, set up different break points, which reshape the signal in. With the input being a triangle wave, the output will be a sinewave.

MODULATOR

The sinewave output of U111 is fed to U112, an Operational Transconductance Amplifier (OTA), a special Op-Amp, whose output gain is controlled by the input at its pin 5. With no signal present at the EXT MOD IN connector, and the MOD switch in the OFF position, the gain of U112 is controlled strictly by R148.

A signal input at the EXT MOD IN/1 kHz OUT connector will be AC coupled to pin 5 of U112 where it will interact with the gain setting of R148 in proportion to its signal level, thus, modulating the output of U112. Another way that the output of U112 can be modulated is internal. When the MOD switch is in the ON position, it turns ON a 1 kHz phase shift oscillator, whose output is AC coupled and fed to pin 5 U112. This 1 kHz signal is also fed to the EXT MOD/1 kHz OUT connector. The output of U112 is fed to the function switches.

FUNCTION SWITCHES/AMPLIFIERS

All the signals present at the function switches can be individually selected and fed to pre-amp U113 where initial amplification takes place. The output of the pre-amp is fed to AMPLITUDE ADJ control R177. R177 controls the amount of signal fed to the main amplifier, composed of U114 and associated transistors, where final amplification takes place. Varying R177 will change the signal level from near zero to about 20 V_{P-P} out.

DC OFFSET

DC offset is selected by S3. In the OFF mode, DC offset is controlled by R185, an internal trimmer, which is adjusted for zero DC offset. In the ON mode, DC offset is controlled by OFFSET control R127, which allows a control range of ±10V of DC offset on the output signal.

PROTECTION CIRCUITS

Figure 4 is a simplified functional diagram of the Protection Circuits. It is included to show how the individual overload signals are developed. A complete schematic diagram is given in the back of the Maintenance Manual. The component numbers given in Figure 4 are correlated to the schematic diagram.

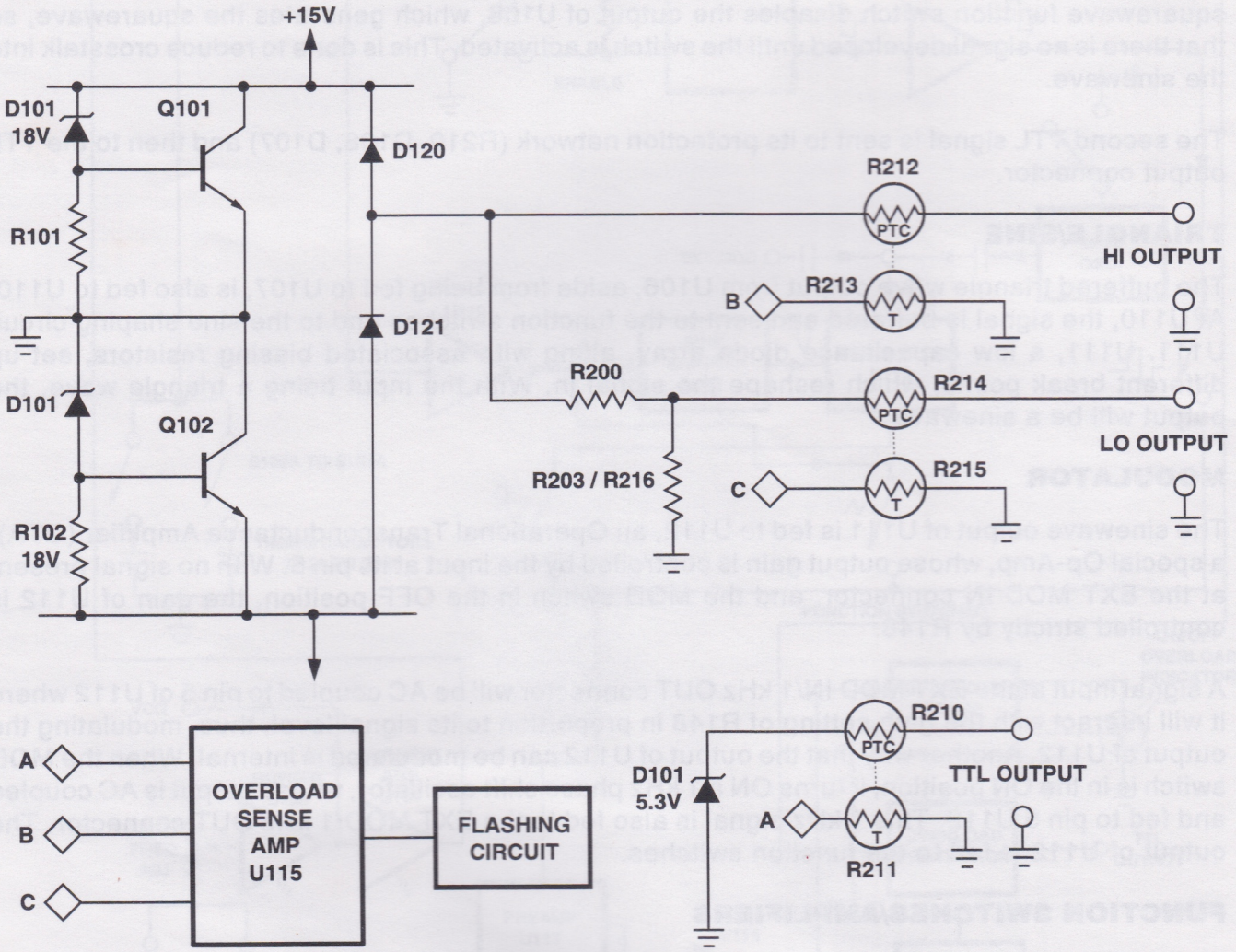


FIGURE 4, Simplified Diagram of Protection Circuits

The protection circuit consists of a Positive Temperature Coefficient (PTC) resistor, a device whose resistance increases with an increase in temperature, and a high power crowbar. When a voltage source higher than $40V_{P-P}$ is connected to either HI or LO output connectors, the crowbar will turn ON and shunt the external source to ground. With current flowing through the crowbar, higher than normal current flows through the PTC causing it to rise in temperature and to continue rising until it reaches its temperature trip point. Once the PTC reaches the trip point, its resistance will increase rapidly to a high point, and for all practical purposes the external voltage source will be isolated from the internal circuitry. To return to normal operation, the overload condition must be removed from the connectors and the PTC must be allowed to cool long enough until it drops below its temperature trip point. Protection for the TTL OUTPUT connector is the same as previously described. Only the external voltage source can be as low as + 8V and the crowbar consists of a single zener diode, D101.

Protection of the other two connectors consists of series limiting resistors.

OVERLOAD INDICATOR

Each of the three PTC's in the protection circuit has a thermistor attached to it which is electrically insulated, but thermally coupled to the PTC. As the temperature of the PTC increases because of an overload condition, the resistance of the thermistor decreases. Each thermistor is connected to a voltage comparator, U115, set to detect a decrease in resistance below a set value, which corresponds to the trip point of the PTC. The outputs of the comparators are connected to a flashing LED circuit consisting of Q112, R301, D301, and D302. Under normal conditions, the outputs of the comparators are high, turning on transistor Q112. This turns on D302, mounted on the front panel. It serves as a power on indicator. When any one of the thermistors drops below the set level, transistor Q112 turns off. Now the current for D302 comes through D301, a flashing LED. Since this current is pulsing, D302 pulses along with D301. Once the PTC/thermistor cools, the voltage at the comparator goes above the trip point. The LED serves as a visual indicator of the trip condition of the PTC.

POWER SUPPLIES

Power to the circuits is supplied by U103 +15V, U104 –15V, U101 +5V, and U102 –5V volt regulators.

CALIBRATION PROCEDURE

SECTION 2

GENERAL

This instrument has been factory calibrated to the specifications set forth in this manual. However, after a period of use, the instrument may require recalibration as a result of component change or replacement.

Before attempting to calibrate this instrument, be sure the unit is operating properly, and that all malfunctions have been corrected. Refer to the Operation Manual to determine the operating conditions of the instrument.

Refer to Figure 5 for locations of calibrating controls.

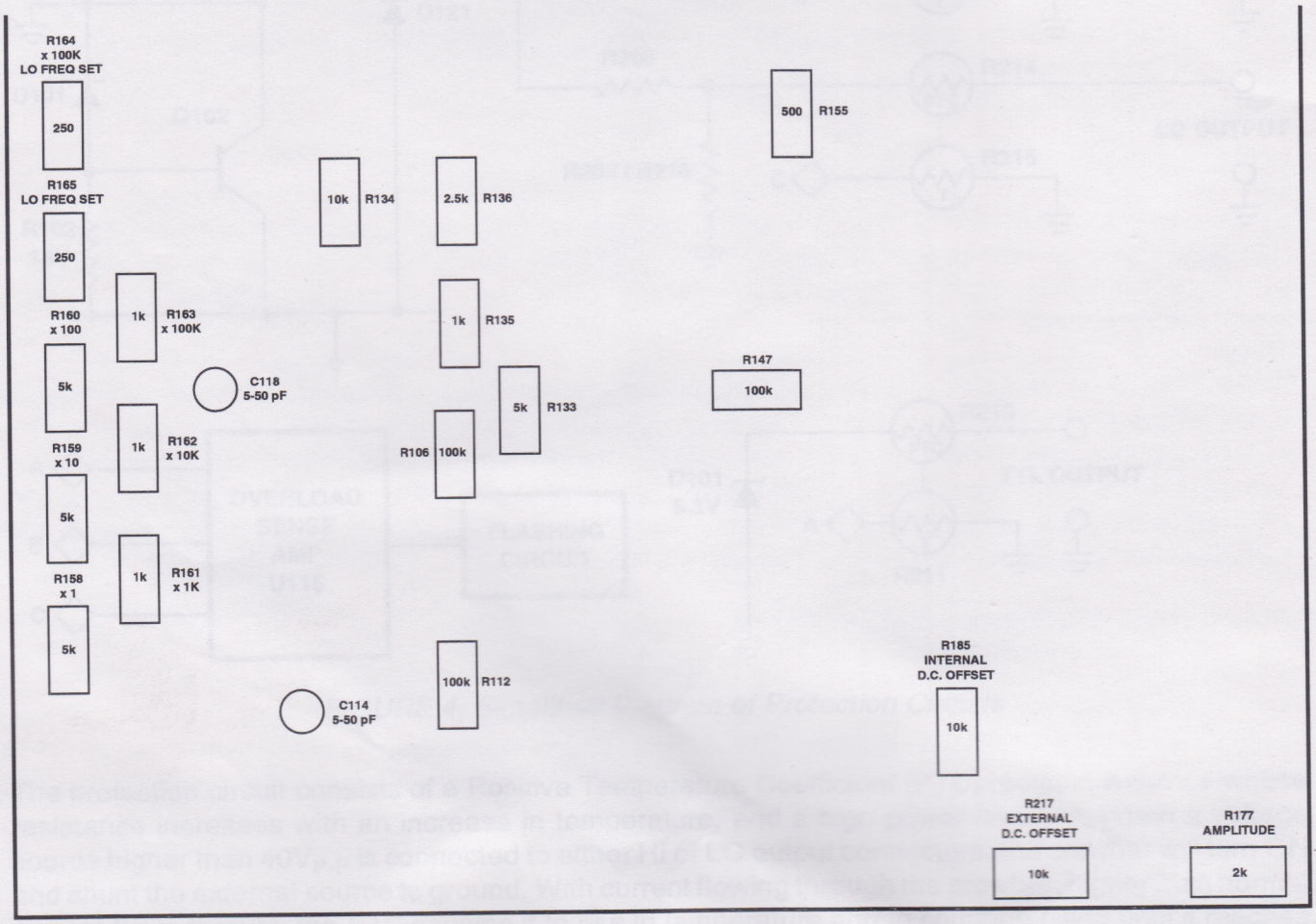


FIGURE 5, Calibration Adjustments

PRELIMINARY CALIBRATION PROCEDURE

1. Set all trimpots to mid position.
2. Turn the 1 kHz MOD and DC OFFSET switches OFF.
3. Push the TRIANGLE function button and the 1k FREQUENCY MULTIPLIER button in.

4. Set frequency dial to 10. Connect an oscilloscope to the HI OUTPUT.
5. Set the LEVEL control completely CW. Adjust R135 for 20 V_{P-P} out.
6. Adjust R106 for symmetry. See Figure 6A.
7. Adjust R112 and R134 to center waveform at zero. See Figure 6B.
8. Press sine FUNCTION button in. Adjust R136 for 20 V_{P-P} out. See Figure 6C. Adjust R147 to center waveform at zero.
9. Readjust R112, R134, R147 if necessary for best sine out.

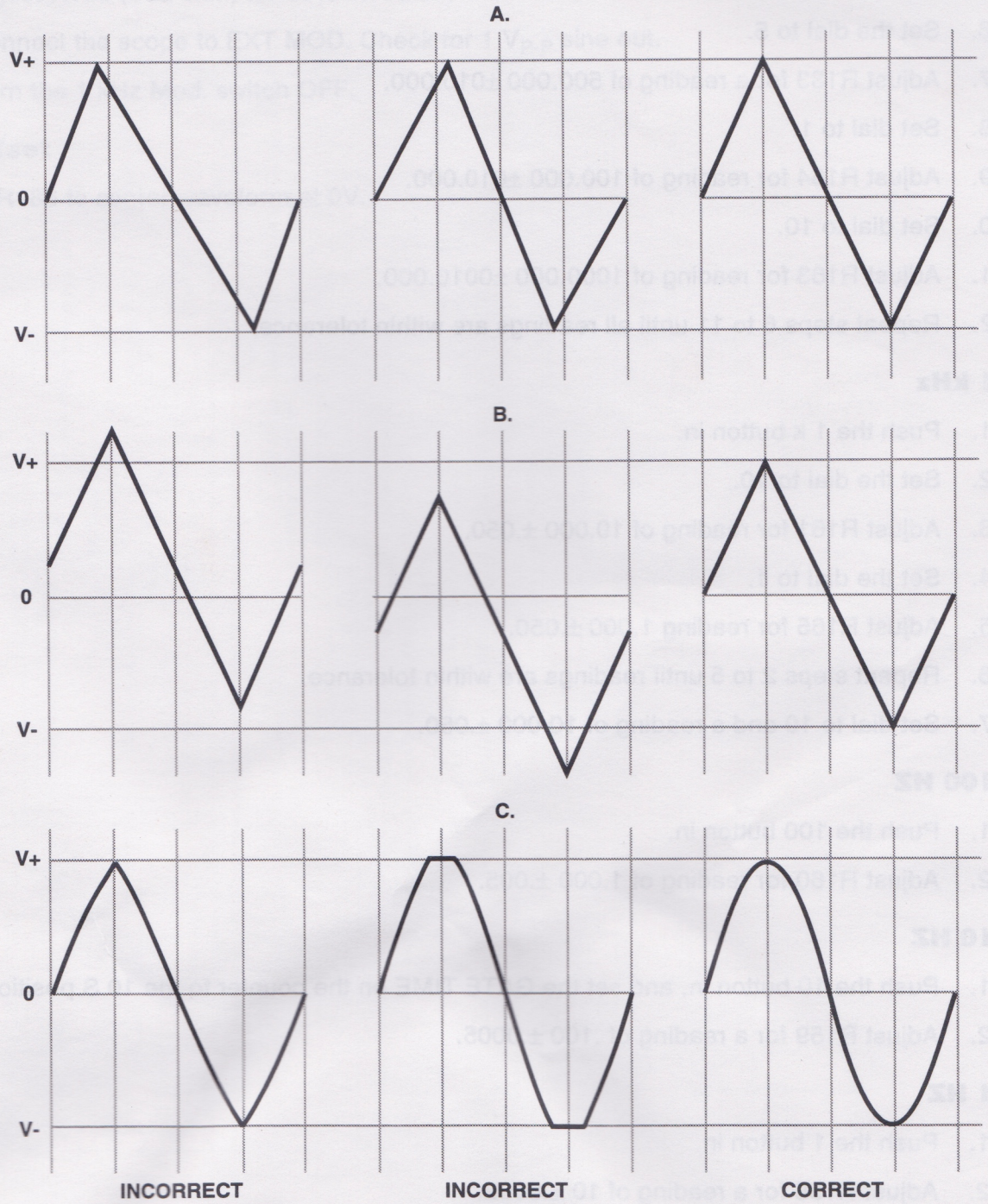


FIGURE 6, Correct and Incorrect Waveshapes

FREQUENCY CALIBRATION

A. 100 kHz

1. Push the 100 k FREQUENCY MULTIPLIER button in and set the dial to 10.
2. Connect the Frequency Counter to the HI OUTPUT. Set GATE TIME to the 1 S position.
3. Adjust C114 for a reading on the counter of 900.000 to 1000.000.
4. Adjust C118 for a maximum signal amplitude out.
5. Adjust C114 for a reading of 1000.000 ±0010.000.
6. Set the dial to 5.
7. Adjust R133 for a reading of 500.000 ±010.000.
8. Set dial to 1.
9. Adjust R164 for reading of 100.000 ±010.000.
10. Set dial to 10.
11. Adjust R163 for reading of 1000.000 ±0010.000.
12. Repeat steps 6 to 11 until all readings are within tolerance.

B. 1 kHz

1. Push the 1 k button in.
2. Set the dial to 10.
3. Adjust R161 for reading of 10.000 ±.050.
4. Set the dial to 1.
5. Adjust R165 for reading 1.000 ±.050.
6. Repeat steps 2 to 5 until readings are within tolerance.
7. Set dial to 10 and a reading of 10.000 ±.050.

C. 100 HZ

1. Push the 100 button in.
2. Adjust R160 for reading of 1.000 ±.005.

D. 10 HZ

1. Push the 10 button in, and set the GATE TIME on the counter to the 10 S position.
2. Adjust R159 for a reading of .100 ±.0005.

E. 1 HZ

1. Push the 1 button in.
2. Adjust R158 for a reading of 10 ±.0002.

F. 10 kHz

1. Push the 10K button in. Set the GATE TIME to the 1 S position.
2. Adjust R162 for a reading of 100.000 ±.500.

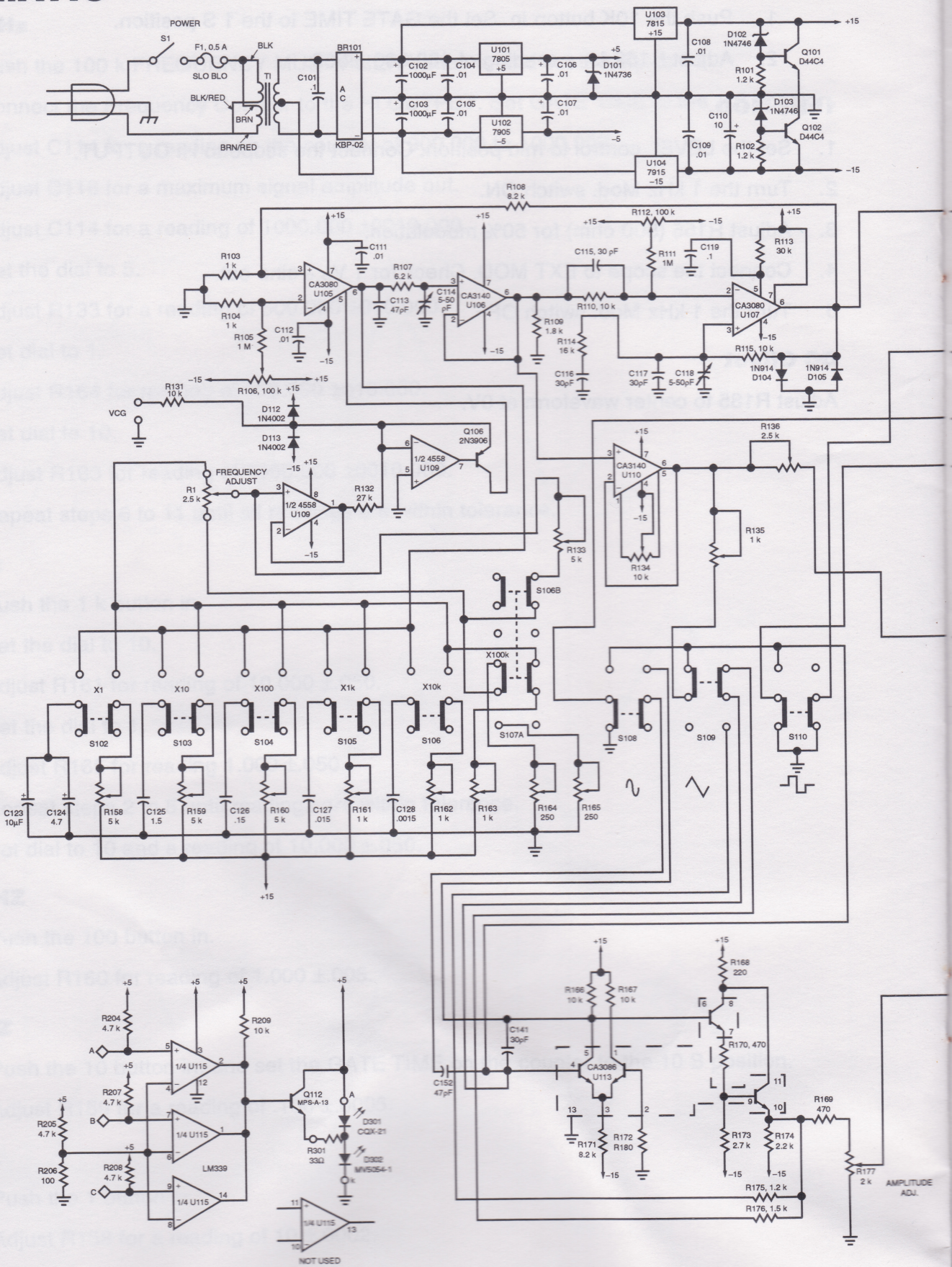
1kHz MOD.

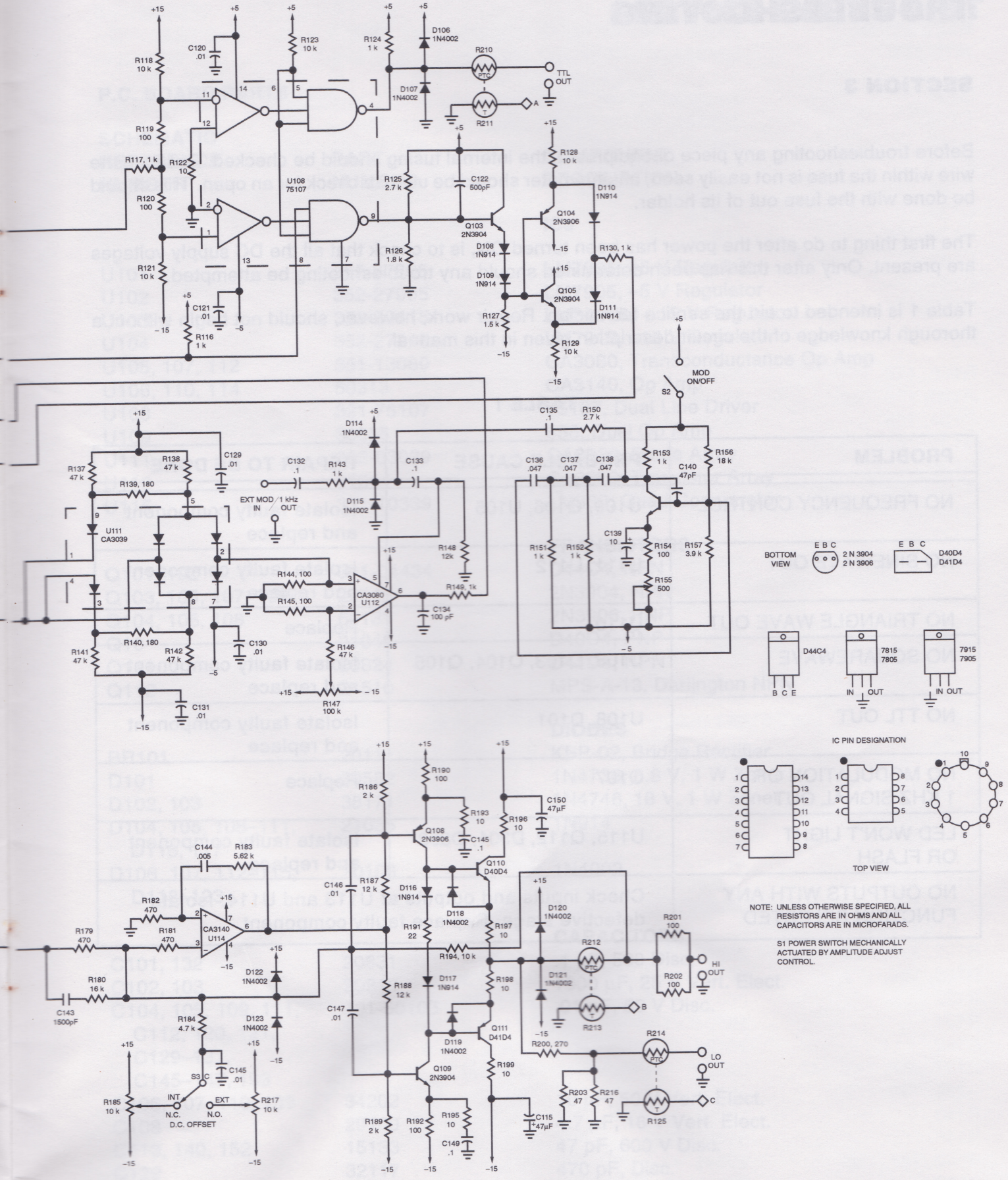
1. Set the LEVEL control to mid position. Connect the scope to HI OUTPUT.
2. Turn the 1 kHz Mod. switch ON.
3. Adjust R155 (500 ohm) for 50% modulation.
4. Connect the scope to EXT MOD. Check for 1 V_{P-P} sine out.
5. Turn the 1 kHz Mod. switch OFF.

DC Offset

Adjust R185 to center waveform at 0V.

SCHEMATIC


POWER
S1
F1, 0.5 A
SLO BLO
BLK
BLK/RED
BRN
BRN/RED
TI
C101
.1
BR101
KBP-02
C102 1000µF
C103 1000µF
C104 .01
C105 .01
U101 7805 +5
U102 7905 –5
C106 .01
C107 .01
D101 1N4736
U103 7815 +15
U104 7915 –15
C108 .01
C109 .01
C110 10
D102 1N4746
D103 1N4746
Q101 D44C4
Q102 D44C4
R101 1.2 k
R102 1.2 k
R108 8.2 k
R103 1 k
R104 1 k
R105 1 M
R106, 100 k
C111 .01
C112 .01
CA3080 U105
R107 6.2 k
C113 47pF
C114 5-50 pF
CA3140 U106
R109 1.8 k
R110, 10 k
R111 1M
R112, 100 k
C115, 30 pF
C119 .1
CA3080 U107
R113 30 k
R114 16 k
C116 30pF
C117 30pF
C118 5-50pF
R115, 10 k
1N914 D104
1N914 D105
R131 10 k
VCG
D112 1N4002
D113 1N4002
Q106 2N3906
1/2 4558 U109
FREQUENCY ADJUST
R1 2.5 k
R132 27 k
CA3140 U110
R133 5 k
R134 10 k
R135 1 k
R136 2.5 k
S106B
X100k
X1
X10
X100
X1k
X10k
S102
S103
S104
S105
S106
S107A
S108
S109
S110
C123 10µF
C124 4.7
R158 5 k
C125 1.5
R159 5 k
C126 .15
R160 5 k
C127 .015
R161 1 k
C128 .0015
R162 1 k
R163 1 k
R164 250
R165 250
R204 4.7 k
R205 4.7 k
R206 100
R207 4.7 k
R208 4.7 k
R209 10 k
1/4 U115
LM339
Q112 MPS-A-13
D301 CQX-21
D302 MV5054-1
R301 33Ω
NOT USED
R166 10 k
R167 10 k
C141 30pF
C152 47pF
CA3086 U113
R168 220
R170, 470
R171 8.2 k
R172 R180
R173 2.7 k
R174 2.2 k
R169 470
R175, 1.2 k
R176, 1.5 k
R177 2 k
AMPLITUDE ADJ.


+15
+5
-15
-5
R118 10 k
R119 100
R117, 1 k
R122 10
R120 100
R121 10 k
C120 .01
C121 .01
R116 1 k
R123 10 k
R124 1 k
D106 1N4002
D107 1N4002
R210 PTC
R211 T
TTL OUT
A
U108 75107
R125 2.7 k
C122 500pF
R126 1.8 k
Q103 2N3904
D108 1N914
D109 1N914
R127 1.5 k
R128 10 k
D110 1N914
Q104 2N3906
R130, 1 k
Q105 2N3904
D111 1N914
R129 10 k
MOD ON/OFF
S2
C135 .1
R150 2.7 k
R153 1 k
R156 18 k
C136 .047
C137 .047
C138 .047
C140 47pF
C139 10
R154 100
R155 500
R157 3.9 k
R151 1 k
R152 1 k
R137 47 k
R138 47 k
C129 .01
R139, 180
U111 CA3039
R140, 180
R141 47 k
R142 47 k
C130 .01
C131 .01
D114 1N4002
C132 .1
R143 1 k
C133 .1
EXT MOD / 1 kHz IN OUT
D115 1N4002
R144, 100
R145, 100
R146 47 k
R147 100 k
R148 12k
R149, 1k
CA3080 U112
C134 100 pF
BOTTOM VIEW
E B C
2 N 3904
2 N 3906
D40D4
D41D4
D44C4
B C E
7815
7805
7915
7905
IN OUT
IC PIN DESIGNATION
TOP VIEW
R186 2 k
R190 100
C150 47µF
R193 10
R196 10
Q108 2N3906
C145 .1
Q110 D40D4
C144 .005
R183 5.62 k
C146 .01
R187 12 k
D116 1N914
D118 1N4002
R182 470
R179 470
R181 470
CA3140 U114
R191 22
R197 10
R194, 10 k
D120 1N4002
R212
R201 100
R202 100
HI OUT
B
R213
R180 16 k
C143 1500pF
D122 1N4002
R184 4.7 k
D123 1N4002
R188 12k
C147 .01
D117 1N914
R198 10
D121 1N4002
D119 1N4002
Q111 D41D4
R200, 270
R214
LO OUT
C
R125
R199 10
Q109 2N3904
R203 47
R216 47
S3
INT
EXT
N.C.
N.O.
D.C. OFFSET
R185 10 k
R217 10 k
R189 2 k
R192 100
R195 10
C149 .1
C115 47µF
NOTE: UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE IN OHMS AND ALL CAPACITORS ARE IN MICROFARADS.
S1 POWER SWITCH MECHANICALLY ACTUATED BY AMPLITUDE ADJUST CONTROL.

TROUBLESHOOTING

SECTION 3

Before troubleshooting any piece of equipment, the internal fusing should be checked. Because the wire within the fuse is not easily seen, an ohmmeter should be used to check for an open. This should be done with the fuse out of its holder.

The first thing to do after the power has been turned ON, is to check that all the DC supply voltages are present. Only after this has been determined should any troubleshooting be attempted.

Table 1 is intended to aid the service technician. Repair work, however, should not begin without a thorough knowledge of the circuit description given in this manual.

TABLE 1

PROBLEM	PROBABLE CAUSE	REPAIR TO BE DONE
NO FREQUENCY CONTROL	U109, Q106, U105	Isolate faulty component and replace
NO SINEWAVE OUT	U111, U112	Isolate faulty component and replace
NO TRIANGLE WAVE OUT	U110	Replace
NO SQUAREWAVE	U108, Q103, Q104, Q105	Isolate faulty component and replace
NO TTL OUT	U108, D101	Isolate faulty component and replace
NO MODULATION OR 1 KHZ SIGNAL OUT	Q107	Replace
LED WON'T LIGHT OR FLASH	U115, Q112, D301, D302	Isolate faulty component and replace
NO OUTPUTS WITH ANY FUNCTION SELECTED	Check inputs and outputs at U113 and U114. Isolate defective stage. Replace faulty component.	

SERVICE PARTS LIST

P.C. BOARD PARTS

SCHEMATIC REFERENCE NUMBER	PART NUMBER	COMPONENT DESCRIPTION
		ICs
U101	352-27805	LM7805, +5 V Regulator
U102	352-27905	LM7905, –5 V Regulator
U103	352-23415	LM340T5, + 15 V Regulator
U104	352-27915	LM7915, –15 V Regulator
U105, 107, 112	351-13080	CA3080, Transconductance Op Amp
U106, 110, 114	50313	CA3140, Op Amp
U108	321-75107	75107, Dual Line Driver
U109	30055	558, Dual Op Amp
U111	302-03039	CA3039, Diode Array
U113	21614	CA3086, Transistor Array
U115	351-10339	LM339, Quad Comparator
		TRANSISTORS
Q101, 102	311-04434	D44C4, NPN
Q103, 105, 107, 109	20845	2N3904, NPN
Q104, 106, 108	60131	2N3906, PNP
Q10	21048	D40D4, PNP
Q111	20824	D41D4, NPN
Q112	21510	MPS-A-13, Darlington NPN
		DIODES
BR101	20111	KBP-02, Bridge Rectifier
D101	30582	1N4736, 6.8 V, 1 W Zener
D102, 103	38171	1N4746, 18 V, 1 W Zener
D104, 105, 108–111, D116, 117	21035	1N914
D106, 107, 112–115, D118–123	20108	1N4002
		CAPACITORS
C101, 132	20631	.1 µF, 500 Disc.
C102, 103	20912	1000 µF, 25 V Vert. Elect.
C104, 105, 109, 111, C112, 120, 121, C129–131, C145–147, 153	401-50103	.01 µF, 50 V Disc.
C106, 107, 110, 139	34202	10 µF, 50 V Vert. Elect.
C108	29109	4.7 µF, 16 V Vert. Elect.
C113, 140, 152	15133	47 pF, 600 V Disc.
C122	32117	470 pF, Disc.
C123	50239	10 µF, 35 V, 10% Tantalum

SCHEMATIC REFERENCE NUMBER	PART NUMBER	COMPONENT DESCRIPTION
C124	20629	4.7 µF, 35 V, 10% Tantalum
C125	40519	1.5 µF, 2%, 50 V Mylar
C126	40518	.15 µF, 2%, 50 V Mylar
C127	40517	.015 µF, 2%, 50 V Mylar
C128, 143	40516	.0015 µF, 125 V, 2.5% Poly.
C134	15293	100 pF, 600 V Disc.
C136–138	462-10473	.047 µF, 100 V Mylar
C142	not used	
C144	15295	.005 µF, 600 V Disc.
C150, 151	29124	47 µF, 50 V Vert. Electrolytic
		POTENTIOMETERS
R106, 112, 147	29118	100 k Trimpot
R133, 158–160	33108	5 k Trimpot
R134, 185	29119	10 k Trimpot
R135, 161–163	32141	1 k Trimpot
R136	39532	2.5 k Trimpot
R155, 165	30024	500 Ohm Trimpot
R164	19617	250 Trimpot
R177	40656	2 k w/switch
R217	40655	10 k
		RESISTORS
R101, 102	38630	1.2 k, 1/2 W, 5%
R103, 104, 116, 117, 124, R130, 149,151-153, 175	20645	1 k, 1/4 W, 5%
R105, 111	60157	910 k, 1/4 W, 5%
R107	514-50622	6.2 k, 1/4 W, 5%
R108, 171	514-50822	8.2 k, 1/4 W, 5%
R109, 126	514-50182	1.8 k, 1/4 W, 5%
R110, 115, 118, 121, 123, 128, 129, 166, 167, 209	50273	10 k, 1/4 W, 5%
R113	514-50303	30 k, 1/4 W, 5%
R114, 180	514-50163	16 k, 1/4 W, 5%
R119, 120, 144, 145, R154, 190, 192, 206	20656	100 Ohm, 1/4 W, 5%
R122, 193, 195	20660	10 Ohm, 1/4 W, 5%
R125, 150, 173	20653	2.7 k, 1/4 W, 5%
R127	20651	1.2 k, 1/4 W, 5%
R131	16504	10 k, 2 W, 5%
R132	20424	27.4 k, 1/2 W, 1%
R137, 138, 141, 142	34213	47 k, 1/2 W, 5%
R139, 140, 172	15339	180 Ohm, 1/4 W, 5%
R143	15268	1 k, 1/2 W, 5%
R146	514-50473	47 k, 1/4 W, 5%
R148, 187, 188	20646	12 k, 14 W, 5%
R156	514-50183	18 k, 1/4 W, 5%

SCHEMATIC REFERENCE NUMBER	PART NUMBER	COMPONENT DESCRIPTION
R157	20655	3.9 k, 1/4 W, 5%
R168	60153	220 Ohm, 1/4 W, 5%
R169, 170, 179, 181, 182	20657	470 Ohm, 1/4 W, 5%
R174	20659	2.2 k, 1/4 W, 5%
R176	514-50152	1.5 k, 1/4 W, 5%
R191	514-50220	22 Ohm, 1/4 W, 5%
R183	514-15621	5.62 k, 1/4 W, 1%
R184	514-50133	13 k, 1/4 W, 5%
R186, 187	20859	2 k, 1/4 W, 5%
R194	514-05103	10 k, 1 W, 5%
R196–199	25512	10 Ohm, 1/2 W, 5%
R200	19614	820 Ohm, 1/2 W, 5%
R201, 202	543-05101	100 Ohm, 2 W, 5%
R203, 206	541-05470	47 Ohm, 1 W, 5%
R204, 205, 207, 208	514-50472	4.7 k, 1/4 W, 5%
		THERMISTORS
R210, 212, 214	40673	Positive Temperature Coefficient
R211, 213, 215	38134	Negative Temperature Coefficient
		MISCELLANEOUS
S101–105	40652A	Pushbutton Switch Assembly, 9 Station
S106A, 107–109, S106B	40653	Pushbutton Switch, 1 Station
	40620-01	P.C. Board
	40058	8 Pin I.C. Socket
	40027	14 pin I.C. Socket
	40672	Heat Sink Bracket
	746-02037	6-32 × 3/8" PHMS/SEMS Type
	4200	6-32 Hex Nut
	21054	Shoulder Washer
		FLASHING LED BOARD PARTS
D301	22970	Red Flashing LED CQX-21
D302	21640	MV5054-1 LED
R301	20652	33 Ohm, 1/4 W, 5%
	40620-11	Flashing LED P.C. Board
		CHASSIS PARTS MISCELLANEOUS
F2	30583	Fuse, 1/2 A
R1	40654	Potentiometer, 2.5 k
S2, 3	22935	Toggle Switch
T1	40671	Transformer
	40622C	Chassis
	40677D	Front Panel
	40623	Dial
	40124	BNC Connector
	40624	Small Knob

SCHEMATIC REFERENCE NUMBER	PART NUMBER	COMPONENT DESCRIPTION
	40510	Blue Pushbutton Knob
	20112	Fuse Holder
	15160	Terminal Strip
	29020	Power Cord
	748-02031	8-32 × 5/16" PHMS/SEMS Type
	746-02025	6-32 × 1/4" PHMS/SEMS Type
	20583	#8 Washer, 7/16; O.D.
	746-02037	6-32 × 3/8" PHMS/SEMS Type
	60196	Circuit Board Supports
	736	Lockwasher, 3/8" Internal
	4200	3/8"-32 Hex Nut
	19164	4-36 × 3/8" BHMS
	15175	4-36 × 3/16" Nut
	18087	#4 Lockwasher
	40678	Mica Washer
	1599-10027	Tie Anchor Base
	1599-00008	Tie Wrap
	2460-90100	LED Hardware

WARRANTY

ENERGY CONCEPTS, INC. warrants this equipment to be free from defective material and workmanship and agrees to remedy any such defect or to furnish a new part in exchange for any part of this unit which under normal installation, use, and service discloses such defect, provided that the unit is delivered by the purchaser to the dealer from whom purchased, or to Energy Concepts, Inc., or to a stipulated agent, intact, for the purpose of examination within a period of three years from the date of sale to the original purchaser and provided such examination discloses in our judgement that it is defective.

This warranty does not apply if the equipment has been subjected to misuse, neglect, improper installation, used in violation of instructions provided by us, or if repaired or in any way altered outside of our factory or authorized service facility, or if the serial number has been removed, defaced or changed.

Any part approved for remedy or exchange hereunder will be remedied or exchanged without charge to the owner.

Energy Concepts, Inc. assumes no liability for injury, damage, or expense claimed to have been incurred through the use or in the installation of our equipment and products.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to assume for us any other liability in connection with the sale of this equipment.

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